



Radio Astronomy projects in ESCAPE and Virtual Observatory

F.Bonnarel, CDS



ESCAPE

- European science cluster for astronomy and particle physics ESFRI :
H2020 funded project
- ESCAPE is federated with other projects within the frame of EOSC
(european open science cluster)
- ESCAPE work packages :
 - WP2 : data and computing cluster (Data Lake)
 - WP3 : free software repository for astronomy and particle physics
 - WP5 : science platforms
 - WP6 : outreach/citizen science
- WP4 (led by CDS) : linking ESFRI projects to EOSC using VO framework



ESCAPE

radio astronomy projects

- LOFAR (Astron)
 - Low Frequency Array (10-250 Mhz)
 - SIA2 / ObsTAP services for 2 D images
- JIVE
 - Joint Infrastructure for VLBI ERIC (european research infrastructure consortium)
 - Hosted by Astron.
- SKAO
 - VO technology integrated in SKA Data distribution policy
 - Future developemts towards SKA regional center
- ALMA (science Archive -ESO)
 - Using VO technology (AladinLite, ESA Sky)
 - ObsTAP and SIA2 services available for science data



LOFAR ObsTAP service

The screenshot displays the ALADIN v10.0 interface, which is used for astronomical data visualization and querying. The main window shows a star field with a central crosshair and a coordinate label $1.339^{\circ} \times 43.02'$. The interface includes a menu bar (File, Edit, Image, Catalog, Overlay, Coverage, Tool, View, Interop, Help) and a toolbar with various icons for navigation and analysis.

A query window titled "TAP access with astron.nl/_system_/slap2/siteside" is open, showing the following details:

- Table: `ivoa.obscore`
- Constraints: `Target: 16 00 01.71645 -43 54 25.1123`
- Radius: `33.37'`
- Query: `SELECT TOP 10 * FROM ivoa.obscore WHERE CONTAINS(POINT('ICRS', s_ra, s_dec), CIRCLE('ICRS', 240.00715, -43.90697, 0.55616)) = 1`

The data table below the query window shows the following columns and rows:

| access_url | dataprod... | dataprod... | calib_le... | obs_coll... | obs_id | obs_title | obs_publ... | obs_c |
|---------------------------------------|-------------|-------------|-------------|-------------|--|-------------|-------------|-------|
| https://... | image | image | 0 | unnamed | <code>msss/data/mosaics/hba/M085_03/mosaics_PBCorr_cut/averaged_map_cut_circbeam_BPA.fits</code> | averaged... | ivo://as... | |
| https://... | image | image | 0 | unnamed | <code>msss/data/mosaics/hba/M085_03/mosaics_PBCorr_cut/mosaic-band0_sub.fits_miriad_conv1_circbeam_BPA.fits</code> | mosaic-b... | ivo://as... | |
| https://... | image | image | 0 | unnamed | <code>msss/data/mosaics/hba/M085_03/mosaics_PBCorr_cut/mosaic-band1_sub.fits_miriad_conv1_circbeam_BPA.fits</code> | mosaic-b... | ivo://as... | |
| https://... | image | image | 0 | unnamed | <code>msss/data/mosaics/hba/M085_03/mosaics_PBCorr_cut/mosaic-band2_sub.fits_miriad_conv1_circbeam_BPA.fits</code> | mosaic-b... | ivo://as... | |
| https://... | image | image | 0 | unnamed | <code>msss/data/mosaics/hba/M085_03/mosaics_PBCorr_cut/mosaic-band3_sub.fits_miriad_conv1_circbeam_BPA.fits</code> | mosaic-b... | ivo://as... | |
| https://... | image | image | 0 | unnamed | <code>msss/data/mosaics/hba/M085_03/mosaics_PBCorr_cut/mosaic-band4_sub.fits_miriad_conv1_circbeam_BPA.fits</code> | mosaic-b... | ivo://as... | |
| https://... | image | image | 0 | unnamed | <code>msss/data/mosaics/hba/M085_03/mosaics_PBCorr_cut/mosaic-band5_sub.fits_miriad_conv1_circbeam_BPA.fits</code> | mosaic-b... | ivo://as... | |
| https://... | image | image | 0 | unnamed | <code>msss/data/mosaics/hba/M085_03/mosaics_PBCorr_cut/mosaic-band6_sub.fits_miriad_conv1_circbeam_BPA.fits</code> | mosaic-b... | ivo://as... | |
| https://... | image | image | 0 | unnamed | <code>msss/data/mosaics/hba/M085_03/mosaics_PBCorr_cut/mosaic-band7_sub.fits_miriad_conv1_circbeam_BPA.fits</code> | mosaic-b... | ivo://as... | |

ALMA science archive ObsTAP service within Aladin

v10.0 *** BETA VERSION (based on v10.073) ***

File Edit Image Catalog Overlay Coverage Tool View Interop Help

Available data → 21973 / 219
 • in view • out view

Command: 06:05:41.72100 -86:37:55.0200

Frame: ICRS Projection: Aitoff

DSS SDSS 2MASS WISE GALEX PLANCK AKARI XMM Fermi Gaia Simbad NED

DSS2 color

Aladin

Field: s_region
 Value: Polygon ICRS
 91.486637 -86.631948
 91.482204 -86...
 Unit: deg
 UCD:
 Utype:
 region bounded by observation

Server selector

Others File FoV... Tools...

Image servers: Aladin images, SkyView, Sloan, DSS..., V.A..., Archives..., Others...

Catalog servers: All, VizieR, SIMBAD, SELECT FROM, TAP, Gaia, SkyBot, NED, VO, Others..

beta.cadc-ccda.hia-ihp.nrc-cnrc.gc.ca Mode: Generic

Construct your query, verify and execute.

Table: alma.obscore Set ra, dec

Select: All

Constraints: Add new Max rows:

Target: 6 05 41.72100 -86 37 55.0200

Radius: 128.7° CIRCLE Add

access_format
 calib_level
 s_ra
 s_dec
 s_fov

Refresh query Check.. SYNC Async jobs>>

SELECT TOP 100 * FROM alma.obscore

Reset Clear SUBMIT Close ?

15° 112.9° x 61.7°

Search

| | calib_level | s_ra | s_dec | s_fov | s_region | t_min | t_max | Observation En. | t_exptime | t_re |
|-----------|-------------|-----------------|---------------|-----------------|----------|-----------------|--------------|-------------------|-----------|------|
| text/html | 2 | 91.423837500... | -86.63195 | 26.564235597... | FoV | 2.2102533595... | 57145.964021 | 2015-05-03T23:... | 1300.32 | |
| text/html | 2 | 91.423837500... | -86.63195 | 26.564235597... | FoV | 2.2102533595... | 57145.964021 | 2015-05-03T23:... | 1300.32 | |
| text/html | 2 | 91.423837500... | -86.63195 | 26.564235597... | FoV | 2.2102533595... | 57145.964021 | 2015-05-03T23:... | 1300.32 | |
| text/html | 2 | 91.423837500... | -86.63195 | 26.564235597... | FoV | 2.2102533595... | 57145.964021 | 2015-05-03T23:... | 1300.32 | |
| text/html | 2 | 73.14289725 | -85.588400972 | 26.564235597... | FoV | 2.2840199243... | 57145.964021 | 2015-05-03T23:... | 151.2 | |
| text/html | 2 | 73.14289725 | -85.588400972 | 26.564235597... | FoV | 2.2840199243... | 57145.964021 | 2015-05-03T23:... | 151.2 | |
| text/html | 2 | 73.14289725 | -85.588400972 | 26.564235597... | FoV | 2.2840199243... | 57145.964021 | 2015-05-03T23:... | 151.2 | |
| text/html | 2 | 73.14289725 | -85.588400972 | 26.564235597... | FoV | 2.2840199243... | 57145.964021 | 2015-05-03T23:... | 151.2 | |

select from -- all collections --

exp. sort view scan filter

ALMA science archive

url in ObsCore response is pointing towards the science archive native interface in the browser

Available data → 21973 / 219'
 In view Out view

Command
 DSS SDSS 2MASS WISE GALEX PLANCK AKARI XMM Fermi Gaia Simbad IRIS

Collections → 21973
 Image → 375
 Data base → 5
 Catalog → 20206
 Cube → 10
 Solar system → 47
 Ancillary → 65
 Outreach → 44
 Others → 1218
 Problematic → 3

DSS2 color

Alma Science Archive - Mozilla Firefox
 almascience.eso.org/aa/?member_ous_id=uid://A001/X145/X199

ALMA Science Archive
 Query Form Results Table
 Submit download request
 Close Viewer Results Bookmark Export Table Results Help

J2000 06 05 41.721 -86 37 55.02

FoV: 2.22'

Showing 1 of 1 rows.

| Project code | Source name | RA | Dec | Band | Integration | Release date | Velocity resolution | Frequency support |
|----------------|-------------|-------------|-------------|------|-------------|--------------|---------------------|--------------------|
| 2013.1.00623.S | ESO005-G004 | 06:05:41.72 | -86:37:55.0 | 6 | 1300.320 | 2016-12-12 | 38006.03 | 227.81, 246.51 GHz |

ordr em res power t access url access estsize obs publisher ... obs collectio

| | | | | | | | | |
|----|-----------------|------------------|-----------------------|--|--|--|--|--|
| Hz | 7353.7783250... | http://almascien | ADS/JAO, ALMA#2/ ALMA | | | | | |
| Hz | 7888.0240400... | http://almascien | ADS/JAO, ALMA#2/ ALMA | | | | | |
| Hz | 7820.3918826... | http://almascien | ADS/JAO, ALMA#2/ ALMA | | | | | |
| Hz | 7423.7358826... | http://almascien | ADS/JAO, ALMA#2/ ALMA | | | | | |
| Hz | 7353.7783250... | http://almascien | ADS/JAO, ALMA#2/ ALMA | | | | | |
| Hz | 7423.7358826... | http://almascien | ADS/JAO, ALMA#2/ ALMA | | | | | |
| Hz | 7820.3918826... | http://almascien | ADS/JAO, ALMA#2/ ALMA | | | | | |
| Hz | 7980.0340400... | http://almascien | ADS/JAO, ALMA#2/ ALMA | | | | | |

select
 from -- all collections --

exp. sort view scan filter

12:02:55820 -86:36:44.43
 112.9' x 61.7'

LOFAR plans for VO services as discussed at ESCAPE tech Forum 02/2020

- Discovery and Access for Science data
 - Extend service to data cubes, APERTIF, Westerbork data
 - Access : Full retrieval at the moment.
 - SODA services could be useful for APERTIF in the future ?
- See Yan Grange slides for status



JIVE plans for VO services as discussed at ESCAPE tech Forum 02/2020

- Advanced discovery and access of visibility data
 - Coarse grain discovery of Visibility data with ObsTAP (in collaboration with LOFAR/ASTRON) Could work well. To be experimented
 - Provide processing on the ESCAPE Science Platform through Jupiter Notebooks
 - Store parameters used in the processing for further reprocessing
 - Possibility to modify some of them if science result not satisfactory and loop.
 - Provenance
 - calibration of visibility data
 - Instrumental provenance will require a model extension
 - Experiment UWS for staging
- See Mark Kettenis slides for status



ALMA plans for VO services as discussed within the frame of WP4 detailed plan

- Usage of VO standards
 - ObsCore/ObsTAP + SIA2
 - DataLink
 - SODA
 - HiPS via AladinLite
- The implementation of VO services with ALMA data will provide feedback on the VO standards



SKA plans for VO services as discussed within the frame of WP4 detailed plan

- Usage of VO standards
 - Explore ObsCore to describe science data
 - Provenance of datasets
 - TimeSeries : uprising VO standards
 - Create HiPS for simulated images
 - Explore Authentication & Authorisation of services



CDS plans : a visibility data discovery and access prototype

- An internship student (A.Egner) at CDS working with K.Lutz, Y.Stein, M.Louys, F.Bonnarel
 - Subset of visibility data / various provenanec / measurement sets
 - Store MS metadata (casa listobs command) into a database.
 - Map to ObsCore.
 - Add new datasets
 - Finer description. Two possibilities
 - Add Related metadata features
 - uv coverage, beam plot, etc. linked via DataLink
 - Related instrumental configuration : antennas, etc..
 - Additional metadata columns for visibility data description in collaboration with ASTRON/LOFAR/JIVE
 - Extra free columns in Obscore or propose a standard extension ?
- Extend collaboration with Nancay/ NENUFAR



In addition :

- Italian radio astronomy groups testing ObsCore, Caom and SODA (INAF)
- Collaborations between the various projects and VO expertise centers
- Collaboration with other ESCAPE WP = science platform, software repository, DataLake
- Participation of european radio astronomy projects to IVOA Radio Astronomy Interest Group

